LA-UR-20-29347
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Title:	Los Alamos National Laboratory Nuclear Explosives Safety Office - An Overview
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Intended for:	Presentation to J. Meyer (NA-12)
Issued:	2020-11-13

Los Alamos National Laboratory Nuclear Explosives Safety Office - An Overview

A brief explanation of Nuclear Explosive Safety (NES) at LANL

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November 13, 2020

Managed by Triad National Security, LLC for the U.S. Department of Energy's NNSA

Overview

What are the requirements for Nuclear Explosives Safety (NES)?

- What are the requirement for NESSG Certification?

How does LANL meet the NES requirements?

What are the requirements for Nuclear Explosives Safety?

- DOE O 452.1, DOE O 452.2, DOE O 452.4, NNSA SD 452.2, and ADA for Stockpile Management memo (Aug. 31, 2018)

Nuclear Explosive Safety Study Groups (NESSG) are convened to evaluate NEOs to determine if positive measures are adequate to meet the Standards as specified in DOE O 452.2E - Nuclear Explosive Safety, DOE O 452.4E – Security and Use Control of Nuclear Explosives and Nuclear Weapons, and NA SD 452.2 - Nuclear Explosive Safety Evaluation Processes, or their successor directives.

- Require that Nuclear Explosives Safety assessments be performed on all Nuclear Explosive Operations (NEOs).
- Require that Nuclear Explosives Security and Use Control assessments be performed on all NEOs.
- NES Organizations must supply sufficient certified Nuclear Explosive Safety Study Group Members to perform up to 3 concurrent active evaluations.
- Define requirements for training and certification of Nuclear Explosive Safety Study Group (NESSG) members.
- Require NES evaluation personnel selected for a given NES evaluation will be able to devote their time for the duration of the NES evaluation. Conflicting assignments must be resolved in favor of NES evaluation duties from the date the input documentation is made available until conclusion of the NES evaluation.
- Require NESSG members meet certification requirements including: Personal Characteristics, Education, Technical Proficiencies, Training, and Independence. In particular, NES-certified personnel must:
  - Make objective, independent judgments regarding the NES adequacy of systems, operations, and processes.
  - Not be subject to management influence in performing their NES obligations and must not have current responsibility for the design, development, production, or testing of the specific nuclear explosive, NEO, facility, or management system under evaluation;
  - Not have responsibility for advocacy of special interests of any organization or for defending the specific nuclear explosive, NEO, facility, or management system under evaluation;
  - Not participate in the preparation of NESS input technical documentation, operational safety review (OSR) supporting documentation, NES change evaluation (NCE) input, or presentation of briefings or demonstrations.

What are the requirements to become a NNSA-certified NESSG member?

- Defined by NNSA Supplemental Directive (SD) 452.2A and W-NES-20-0015U

NESSG certification is based on demonstrated

- Personal Characteristics
- Education
- Experience
- NES-Specific Training
- Independence
- Technical Competencies in NES-specific areas
- Active Participation as a member-in-training in 2 or more NES Evaluations

Note: The NESSG Certification process can take a year or more depending on the candidate's background.

**See backup slides for specific details on NESSG certification requirements.*

What are the requirements for Nuclear Explosives Safety?

- Triad, LLC Statement of Work

Triad, LLC Statement of Work for Contract No. 89233218CNA000001 includes:

- Provide research and development and scientific capabilities that enable safe nuclear explosive operations.
- Provide scientific and engineering capabilities that support assessment, dismantlement, manufacturing and refurbishment of the enduring stockpile at a number of sites.
- Section 1.0 Science and Technology

  1.1.3 Surveillance and Surety

  (x) Support for Nuclear Explosive Safety evaluations for the approval of nuclear explosive operations.

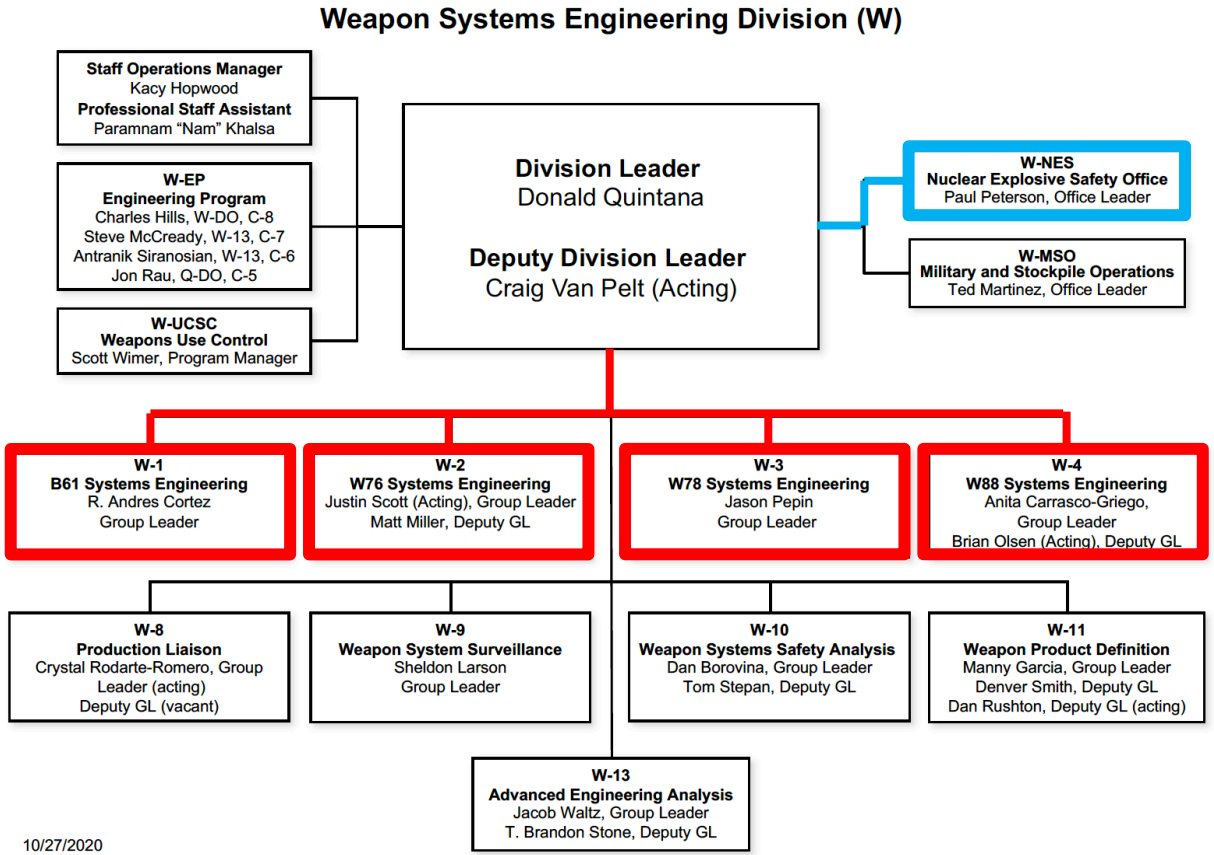
  1.1.5 Production Support

  (xv) Support for Nuclear Explosive Safety evaluations for the approval of nuclear explosive operations.

How does LANL meet the NES requirements?

- Independence of the Nuclear Explosive Safety Office

To preserve independence from Weapon Systems, LANL (under Triad) re-organized the reporting lines for the LANL NES Office. W-NES now resides within the Weapon Systems Engineering Division Office and reports directly to the Division Leader.



LANL Nuclear Explosive Safety Office

- Roles and Responsibilities (see W-NES-AD-0001U)

LANL W-NES GOALS / PRINCIPAL AREAS OF FOCUS

- **Provide Trained and Certified Nuclear Explosive Safety Study Group Members**
- **Provide Trained and Certified Nuclear Explosive Safety Study Group Members for Security and Use Control Studies**
- Provide expertise on the safety and surety of the National Nuclear Security Administration (NNSA) stockpile systems
- Provide NES advisors (as requested) for DoD Nuclear Weapon Safety Studies (NWSSG). (Note: This is a split responsibility with LANL Military Liaison Office (W-MSO).
- Participate in Accident Response Group (ARG) as Weapon Safety and Surety Experts (WRSET)

PARTICIPATION IN INTERNAL, NNSA, & INTERNATIONAL WORKING GROUPS AND COMMITTEES

- Nuclear Safety Research and Development (NSR&D) Working Group
- High-Explosive Violent Reaction (HEVR) Working Group
- Plastic-Bonded Explosive 9501 (PBX 9501) Weapon Response Working Group
- Plastic-Bonded Explosive 9502 (PBX 9502) Weapon Response Working Group
- Los Alamos National Laboratory Surety Working Group
- Defense Nuclear Facility Safety Board (DNFSB)
- Mutual Defense Agreement Joint Working Group 44 (JOWOG 44) *(currently JOWOG 44 Lead)*
- Special Projects

INTERFACES WITH OTHER PROGRAMS

- Direct Stockpile Work Tail Number Activities
- Enhanced Surveillance and Surveillance Campaigns
- High Explosive Science Campaign

FY20 & FY21 NES Workload (NES, NWSSG, & ARG only)

FY20 NES Activities

- DOE 452.2F Order Review (Oct. 2019)
- WGF-A&C NWSSG (Nov. 13-15, 2019)
- B61 NESS Validation (Nov. 2019 – June 2020)
- HRP Swab Test NCE (Dec. 5, 2019)
- PDMLink for Special Tooling NCE (Jan. 14, 2020)
- 12-99 Bay 8 NEO Authorization NCE (Jan. 15, 2020)
- **W78 Operational Safety Review (Jan 28 – Sept 30)**
- B61 Failed Test NCE (March 24-25, 2020)
- Pantex Security Armament NCE (Mar. 25-26)
- ALT370-PT3931 NCE (April 17-19, 2020)
- CMS B61-12 NCE (April 2020)
- W80 AU#1 NCE (April 2020)
- W80 AU#2 NCE (April 2020)
- Pantex LPS NCE (April 2020)
- CMS-FPCU NCE (May 2020)
- B61 614 Validation (May 2020)
- B61-12 CBSAnP FPCU NCE (June 17, 2020)
- NNSA SD 452.2 re-write (Aug. 2020)
- WGF-C NWSSG (Sept 15-17, 2020)

Projected FY21 NES Activities

- **W87 Operational Safety Review (OSR)**
- **W76 Operational Safety Review (OSR)**
- **W80 Operational Safety Review (OSR)**
- **W84 Known State Nuclear Explosive Safety Study (NESS)**
- **Over-the-Road Nuclear Explosive Safety Study (NESS)**
- **W88 ALT940 Nuclear Change Evaluation (major NCE)**
- 15-20 Nuclear Change Evaluations (NCEs)
- 3-4 DoD Nuclear Weapon Safety Studies (NWSSGs)
- 2-3 ARG Exercises

Dedicated time requirements for a study

Major studies

~5-6 weeks for preparation

~1-2 months for the study

Minor studies

~1-2 weeks for preparation

~1-3 days for the study

LANL Nuclear Explosive Safety Office

- Current Status and Future Planning

The LANL NES Office is currently comprised of 7 members.

- LANL seeks to provide senior, experienced staff as NESSG members. Graduate work is preferred and encouraged. Of the current LANL NESSG members, we have members with degrees in electrical engineering, electrical and computer engineering, mechanical engineering, metallurgical engineering, physics, and mathematical statistics/environment management/public health, including:
  - 3 PhD (with a 4th current in progress)
  - 6 MS
  - 2 PE
  - 2 Graduates of Navy Nuclear School
- Three LANL NES members are stationed at Pantex Plant to provide daily NES support to Pantex production & dismantlement operations. In FY20 and FY21 the LANL NES members stationed at Pantex have been heavily utilized by NNSA to allow Nuclear Explosives Safety Studies to continue in spite of LANL/NNSA travel restrictions during the COVID-19 Pandemic.
- Four additional LANL NES members are stationed at LANL to support NES and LANL System Safety.

LANL NES Succession Planning

- The senior Pantex member of the LANL NES Team is planning to retire in the next 2-12 months.
  - A replacement has already been identified and completed NESSG certification in August FY19.
- Three additional LANL NES Team members (one stationed at Pantex, 2 stationed at LANL) are planning to retire in the next 2-5 years.
  - One replacement has been hired and completed NESSG certification in August FY20.
  - Over the next three years, LANL will need to hire and certify 2-3 additional personnel.

Questions?

Backup slides

What are the requirements for NESSG Certification ?

- Personal Characteristics

From NNSA SD 452.2A

All NNSA contractor NES-certified personnel must

(1) bring reasoned judgment to nuclear explosive operation (NEO) evaluations,

(2) have the ability and willingness to question and challenge NNSA line management safety statements and rationale for issues with the potential to affect NES, and

(3) be able and willing to actively participate as part of a team and to take unpopular stands when warranted.

In addition, NNSA contractor NESSG members must

(1) have the ability to

(a) develop appropriate NES evaluation approaches and contribute to effective planning meeting decisions;

(b) critically assess input documentation, briefings, and demonstrations;

(c) develop and pursue relevant lines of inquiry;

(d) articulate NES concerns; and

(e) develop appropriate feedback; and

(2) have oral communication skills to participate effectively in deliberations and written communication skills to clearly document conclusions.

How does LANL meet the NES requirements?

- Personal Characteristics

Required personal characteristics are screened during the hiring process for NES members. These characteristics are further evaluated by the assigned NES mentor(s) as part of two (or more) NES studies as a member-in-training. During these NES studies, the member-in-training is expected to participate fully as an independent NES member. As such, they should demonstrate the following personal characteristics.

- Reasoned judgement
- Independence
- Willingness and ability to question and challenge NNSA line management on NES issues
- Willingness and ability to actively participate as part of a team and to take unpopular stands when warranted
- Ability to develop appropriate NES evaluation approaches
- Ability to contribute to effective planning meeting decisions
- Ability to critically assess input documentation, briefings, and demonstrations
- Ability to develop and pursue relevant lines of inquiry
- Ability to develop articulate NES concerns
- Ability to develop and provide appropriate feedback
- Ability to participate effectively in deliberations
- Oral communication skills
- Written communication skills

What are the Nuclear Explosives Safety requirements?

- Education

From NNSA SD 452.2A

A Bachelor of Science degree in engineering, physics, materials science, or chemistry, with a strong preference for individuals with advanced engineering degrees. The director of the Nuclear Explosive Safety Division may consider other technical degrees in conjunction with the appropriate experience.

What are the Nuclear Explosives Safety requirements?

- Technical Proficiencies – Expert-Level Knowledge

From NNSA SD 452.2A & DOE-STD-1185-2007

NESSG-certified personnel must have an extensive depth and breadth of knowledge in the following areas so they can provide sound advice in the absence of procedural guidance.

(1) DOE O 452.1E, *Nuclear Explosive and Weapon Surety Program*, dated 01-26-15, or most recent successor document

(2) DOE O 452.2E, *Nuclear Explosive Safety*, dated 01-26-15, or most recent successor document

(3) SD 452.2E, *Nuclear Explosive Safety Evaluation Processes*, dated 01-26-16, or most recent revision

What are the Nuclear Explosives Safety requirements?

- Technical Proficiencies – Working-Level Knowledge

NES-certified personnel must have sufficient knowledge in the following areas to ensure they are able to effectively monitor and assess operations and activities, apply performance and safety standards, and recognize the need to consult appropriate reference materials or seek expert-level advice.

(1) Physics of nuclear weapons and explosives

(2) Materials used in nuclear weapons and nuclear explosives and their respective hazardous properties

(3) Internal design of nuclear explosives

(4) Nuclear detonation safety design concepts

(5) Effects of abnormal environments on nuclear explosives

(6) One-point safety and related issues

(7) Fusing, arming, control, and ancillary systems in nuclear weapons

(8) Explosives and pyrotechnics and their applicability in nuclear explosives

(9) Detonators

(10) Hazards of squibs, propellants, and other pyrotechnics used in nuclear explosives

(11) Facilities used to assemble, disassemble, stage, test, and handle nuclear explosives

(12) Facility safety equipment that interfaces with nuclear explosives

(13) Electrical and electromagnetic isolation systems and their importance to NES

NESSG Certification Requirements

– Technical Competencies – Working-Level Knowledge (continued)

(14) Fire protection systems and their importance to NES

(15) Threats such as seismic disturbances, extreme weather, external fires, other natural phenomena, and aircraft crashes

(16) Tooling, rigging, and hoisting equipment used for handling nuclear explosives

(17) Control of electrical equipment used in nuclear explosive areas

(18) Requirements for the safe offsite and onsite transportation of nuclear explosives

(19) Nuclear safety requirements for the safety of nuclear explosive operations at Nevada National Security Site (NNSS)

(20) Nuclear explosive safety rules (NESRs) for NEOs conducted at the Device Assembly Facility at NNSS

(21) Technical communications, including demonstrated proficiency in written communication, oral communication, interpersonal communications, and proficiency in writing a defensible NESS finding

(22) Explosive safety requirements in DOE-STD-1212-2012, *Explosives Safety*, dated June 2012 (or most recent revision), associated with general operations safety guidelines, work environment, area controls, electrical storms, lightning protection, static electricity, electrostatic discharge, electrical equipment and wiring, material handling, transportation, stand-off distance

(23) Requirements in DOE O 452.4C, *Security and Use Control of Nuclear Explosives and Nuclear Weapons*, dated August 28, 2015 (or most recent revision), for protection, security, and control of nuclear explosives and nuclear weapons

(24) Requirements in 10 CFR Part 712, *Human Reliability Program*

NESSG Certification Requirements

– Technical Competencies – Familiarity-Level Knowledge

NES-certified personnel must have adequate knowledge of, or exposure to, the following subjects and processes to permit effective discussions with individuals having greater knowledge.

(1) United States (US) nuclear stockpile

(2) DOE-NA-STD-3016-2018, Hazard Analysis Reports for Nuclear Explosive Operations

(3) DOE O 420.1C Chg 2 (MinChg), Facility Safety

(4) DOE O 420.1C Chg 3 (LtdChg), Facility Safety.

(5) 10 CFR Part 851, *Worker Safety and Health Program*

(6) 10 CFR Part 830, Subpart A, *Quality Assurance Requirements*

(7) Documented safety analysis requirements of 10 CFR Part 830, *Nuclear Safety Management*, Subpart B, *Safety Basis Requirements*

(8) The USQ process with respect to its impact on NEOs and associated activities and facilities

(9) Technical safety requirements as described in 10 CFR 830.205, *Technical safety requirements*

(10) The impact of software quality assurance on NES

(11) Safety analysis techniques and their application to NEOs, facilities, and associated activities

How does LANL meet the NES requirements?

- Technical Proficiencies

Each candidate's technical competence is determined through a written examination (affectionately known as the NES Dissertation). Each NES member-in-training is required to demonstrate expert-level, working-level, or familiarity-level knowledge and competence in the technical subject areas listed in DOE-STD-1185-2007. Sufficiency is determined by the mentor and the LANL NES lead. The final written documents are stored under LANL document control.

What are the Nuclear Explosives Safety requirements?

- Training

From NNSA SD 452.2A

NNSA contractors providing NES-certified personnel must ensure that their NESSG members and NES representatives receive the training required to achieve and maintain the technical proficiencies needed to meet the requirements established in this addendum. Contractors must also ensure that a process exists for experienced NES personnel to convey useful knowledge to less-experienced NES personnel.

What are the Nuclear Explosives Safety requirements?

- Participation and Continuing Education

(a) NESSG members must participate in two major NESSG activities (NESSs or OSRs) every 3 years to remain certified. Two NCEs, NWSSG studies, or Accident Response Group (ARG) exercises may be substituted for one NESS or OSR with concurrence of the certifying official.

(b) NESSG members must participate in a minimum of 30 hours of office-, facility-, and position-specific continuing training per year.

How do you prepare for a NES Study?

- from NNSA SD 452.2A, Attachment 4

NESSG PREPARATION. To prepare the NESSG to conduct the NESS, the following NESS preparatory activities should be conducted in sequence (paragraphs 5a-5d, following): a. Study-specific NESSG Training.

- (1) For operation-specific studies, study-specific NESSG training is typically held at the design agency 1 month or less before the orientation meeting. Although specific content is defined at the planning meeting, study-specific training must address the input topics related to nuclear explosive design as well as the features and attributes important to NES at relevant levels of assembly. Particular focus must be directed to characteristics important to the design of the proposed NEOs, and susceptibilities to possible environments in which the NEOs will be performed.
- (2) For MSs, the need for study-specific training will be determined at NESS planning meetings. If study-specific training is deemed useful, the NESSG Chair and Project Team will define the approach, content, provider, and venue as appropriate to each study.
- b. Input Documentation Delivery. SIID completion and availability must coincide with, or shortly precede, the start of the orientation meeting.
- c. Orientation Meeting. The primary objectives of the orientation meeting are to introduce the NESS subject and SIID content and organization, and to attain NESSG agreement on the planned NESS approach, agenda, and schedule. Commitments to support the agreed-upon schedule must be secured from all participants. (1) NESSG familiarization must focus on proposed NEOs for operation-specific studies, and on proposed facilities, equipment, processes, and management programs for MSs. SIID content, organization, and hardware/software requirements must be addressed. The level of detail in briefings and demonstrations should reflect the NESSG-familiarization objective of the orientation meeting.
- (2) The detailed NESS agenda developed at the orientation meeting must define the required content and initial schedule for NESS briefings, demonstrations, and other activities, as well as the final NESS preparation elements detailed in the following paragraph. NESS start dates and schedules are tentative until the NESSG determines that the SIID is adequate and the NESSG and Project Team define a suitable preparation period.
- d. NESSG Final Preparation. (1) Consistent with prior NESSG agreements, the NESSG must (a) evaluate the SIID to determine if it is adequate to proceed with the NESS.
- (b) perform individual study and research as needed.
- (c) begin developing lines of inquiry (LOIs) as needed.
- (d) participate in periodic teleconferences with members, advisors, and the Project Team to assess progress, discuss LOIs, and modify the NESS plan as required.
- (2) Lines of inquiry are a communication tool that the NESSG uses to pursue potential NES issues. An LOI is an informal document that the NESSG may use to track issues, focus the oral debate during deliberations, and eventually help produce a written finding, deliberation topic, or narrative for the NESSG report. The LOI is used to state the known facts relevant to an issue, submit written questions to the Project Team, document the answers to those questions, and summarize any conclusions based upon the information provided. The use of LOIs is not required for the NESSG to pursue any particular issue, but its use is encouraged as the LOI is particularly useful during the deliberation and report writing phases of the NES evaluation.
- (3) Sufficient resources and time to accomplish these tasks—normally 3 to 5 weeks after the input documentation is available to the NESSG members—must be allocated.

NNSA SD 452.2 – NESSG member responsibilities

- (1) Prepares for the NES evaluation by reading the input documentation, attending training and orientation meetings, developing lines of inquiry, and researching issues as needed.
- (2) Attends briefings and demonstrations (or NEO observations), and critically evaluates the information presented or observed to ensure that evaluated NEOs (including proposed changes or responses to emerging information affecting an approved NEO) meet the NES Standards and other NES criteria.
- (3) Participates in NESSG deliberations, including, examining all sides of NES issues, resolving lines of inquiry, and developing findings and deliberation topics, as appropriate.
- (4) Uses the criteria in the SD when deliberating, categorizing, and documenting issues in NES evaluations.
- (5) Contributes to the report writing and signs the report indicating approval of report content (except as noted in any minority opinions).

NSPD-28 “Nuclear Weapons Command and Control”

Current Order revisions contained flow-down language

- DOE O 452.1C “Nuclear Explosive and Weapon Surety Program” ((¶ 4.g.(4))
  - Surety Research and Development (R&D).
    - a. Conduct R&D on a broad range of safety and control methods and devices to improve the surety of nuclear weapons and nuclear weapon systems significantly.
      - 1 Identify and characterize physical processes that can lead to unacceptable nuclear explosive response.
      - 2 Identify and address safety issues.
      - 3 Identify areas to improve safety.
    - b. Provide use control options with delay or denial capability that, at a minimum, are equivalent to that associated with current nonviolent disablement systems.
    - c. Pursue technologies that render the unauthorized use of U.S. nuclear weapons impossible without their remanufacture.
- DOE O 452.6 “Nuclear Weapon Surety Interface with the DoD”
  - Contractors operating national laboratories with design responsibilities will—
    - a. ensure that use control design features allow timely authorized use of a nuclear weapon while precluding or delaying unauthorized nuclear detonation;
    - b. conduct research and development on a broad range of safety and control methods and devices to improve the surety of nuclear weapons and nuclear weapon systems significantly; and
    - c. evaluate the criticality safety of a nuclear weapon in both normal and abnormal environments to document the intrinsic safety of the design.
- DOE O 452.3 “Management of the DOE Nuclear Weapons Complex”
  - Manage NWC facilities and programs in a manner consistent with the following national security mission requirements:
    - Extend the lifetimes of weapons currently in the stockpile and incorporate modern technologies and enhanced surety features where necessary in accordance with the Nuclear Weapons Council planning.

LA-UR-08-0081
W-10-07-0094U

DOE O 452.1E Contractor Requirements Document

– Surety Research and Development (R&D)

(1) R&D on a broad range of safety and control methods and devices must be conducted to improve the surety of nuclear weapons and nuclear weapon systems significantly by accomplishing the following:

(a) Identify and characterize physical processes that can lead to unacceptable nuclear explosive response.

(b) Identify and address surety issues.

(c) Identify areas to improve surety.

(2) R&D must provide use control options with delay or denial capability that, at a minimum, are equivalent to that associated with current non-violent disablement systems.

(3) R&D must pursue technologies that render the unauthorized use of U.S. nuclear weapons impossible without their remanufacture.

Additional references

W-NES-AD-0001U – “Los Alamos National Laboratory Nuclear Explosive Safety Office Roles and Responsibilities”

W-NES-20-0015U - “Los Alamos National Laboratory’s Nuclear Explosive Safety Study Group Member Certification Process”